

The Calcareae group of *Begonia* (Begoniaceae) from Borneo, including four new species from Sarawak

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ABSTRACT. Four new species, *Begonia kanaensis* Kiew & C.Y.Ling, *Begonia lingiae* S.Julia, *Begonia rubrotepala* S.Julia and *Begonia sadirensis* Kiew & S.Julia are described from Sarawak, Borneo. Notes on habitat, distribution and additional specimens examined for *Begonia calcarea* and *B. sabahensis* are also provided. A key to the species in the ‘calcareae group’ is provided. The status of the ‘calcareae group’ as belonging to *Begonia* sect. *Diploclinium* or to a new section is discussed. A provisional conservation status is assigned to each species.

Keywords. Begonias, conservation status, sections

Introduction

The most striking feature of the ‘calcareae group’ of begonias in Borneo is flower colour. While the great majority of Bornean begonias have pale pink or white flowers, in this group flower colour ranges from canary yellow, to orangey yellow, to orangey red to bright red.

The first species described in the ‘calcareae group’ was *Begonia calcarea* (Ridley, 1906) and it has proved to be the most widespread, being recorded from the Bintulu, Bau, Kapit, Kuching and Tatau districts in Sarawak. The second, *Begonia sabahensis*, was described from Sabah (Kiew & Tan, 2014). Because the two species are different from the more than 200 other Bornean species, Kiew et al. (2015) assigned this group to ‘doubtful affinity’ and suggested that these yellow/orange/red-flowered species belong to their own, as yet undescribed, section, here informally called the ‘calcareae group’. Recently a further four new species were discovered in Sarawak (Fig. 1).

Species in this group are characterised not only by flower colour but also by a distinct combination of characters that includes the prostrate rhizome; erect, succulent, extremely hispid petiole; the more or less ovate, succulent lamina 8–17.5 × 6–19 cm; separate short, erect male and female inflorescences produced from the prostrate rhizome at ground level (except in *Begonia rubrotepala* that is atypical in producing male and female flowers on long, slender inflorescences trailing on the soil,

rather in the manner of geocarpic figs or runners with only the small apical portion erect); the male inflorescences are 3–6-flowered cymes, sometimes condensed and appearing umbellate; the female inflorescences are single-flowered or, in *B. sadirensis*, a compound cyme; the male flower has four rather fleshy tepals that are broad and more or less isomorphic (except for *B. rubrotepala*); stamen number ranges between 17–47; and flower colour in the male and female flowers is the same, with species in this group having canary yellow, orangey yellow, orangey red or bright red flowers.

Except for *Begonia kanaensis* and *B. sabahensis* that grow from lowland forest to lower montane forest up to 1500 m elevation, most species grow in lowland habitats below 500 m elevation. Most are found in rocky habitats, often near rivers and streams. *Begonia calcarea* grows on a variety of substrates including on limestone or mudstone, *B. lingiae* and *B. sadirensis* grow on sandstone rocks, while *B. rubrotepala* grows on sandy loam soils to within 5 m of the water's edge in riparian forest.

Key to *Begonia* species in the 'calcarea group'

- 1a. Upper surface of laminas conspicuously hairy 2
- 1b. Upper surface of laminas glabrous or with occasional hairs 4
- 2a. Leaves crowded in a tuft; female tepals c. 6×7 mm; capsules $11\text{--}21 \times 15\text{--}21$
..... *B. calcarea*
- 2b. Leaves spaced with internodes 1–10 cm long; female tepals $10\text{--}15 \times 5\text{--}7$ mm;
capsules $8\text{--}12 \times 11\text{--}15$ mm 3
- 3a. Laminas longer than wide, $8\text{--}12.5 \times 6\text{--}11.5$ cm, petioles to 8.5 cm long; flower
yellow tinged orange; capsules $10\text{--}12 \times 12\text{--}15$ mm *B. lingiae*
- 3b. Laminas as wide or wider than long, $8.5\text{--}13 \times 8.5\text{--}16.5$ cm, petioles 10–25 cm
long; flower bright red; capsules $8\text{--}9 \times 11\text{--}12$ mm *B. rubrotepala*.
- 4a. Lamina longer than wide, $8\text{--}13 \times 6\text{--}10.5$ cm, basal lobe 0.5–2 cm long; male
tepals more than 1.5 times longer than wide, $12\text{--}14 \times 6\text{--}8$ mm *B. kanaensis*
- 4b. Lamina as wide or wider than long, $8.5\text{--}16.5 \times 8.5\text{--}18.5$ cm, basal lobe well-
developed 1–5 cm long; male tepals less than 1.5 times longer than wide, $5\text{--}14 \times$
 $4\text{--}13$ 5
- 5a. Lamina $13\text{--}17.5 \times 13.3\text{--}19$ cm; stipule c. 5 mm long; flowers deep orangey
red; male and female flowers produced on the same inflorescences; male tepals
isomorphic, $5\text{--}8 \times 4\text{--}7$ mm *B. sadirensis*
- 5b. Lamina $9\text{--}10.5 \times 9\text{--}12$ cm; stipule 7–15 mm long; flowers bright yellow; male and
female flowers produced on separate inflorescences; male tepals dimorphic, outer
tepals $12\text{--}14 \times 9\text{--}11$ mm, inner tepals $11\text{--}13 \times 8\text{--}13$ mm *B. sabahensis*

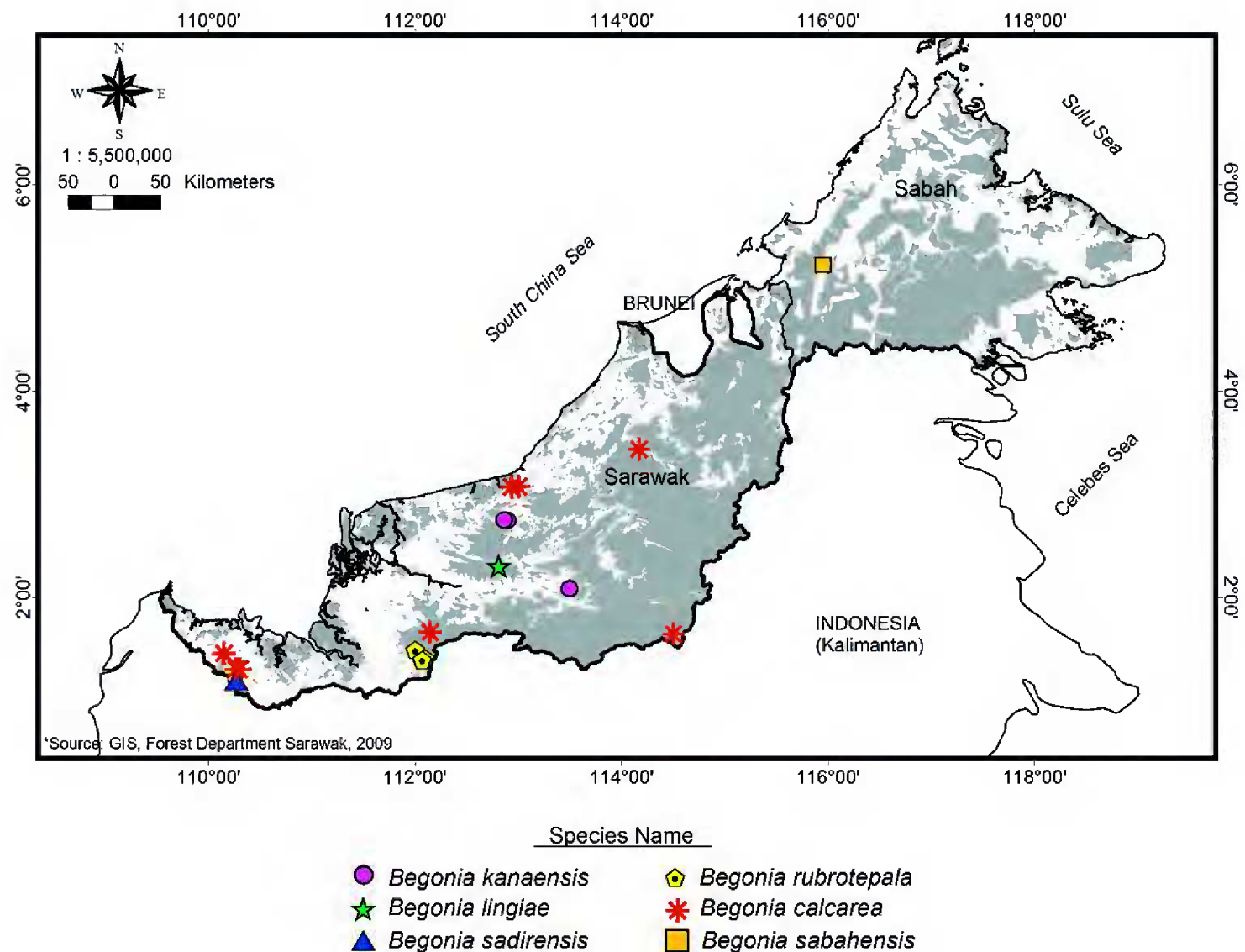


Fig. 1. Species distribution in Borneo.

Species treatment

1. *Begonia calcarea* Ridl., J. Str. Br. Roy. As. Soc. 46: 260 (1906); Kiew & Geri, Gard. Bull. Singapore 55: 115 (2003); Kiew et al., Guide to Begonias of Borneo 68 (2015). – TYPE: Sarawak, Gunung Bra'ang, Haviland *s.n.* (holotype K). (Fig. 2)

Distribution. Endemic in Sarawak where the species is widespread in the Bau, Bintulu, Kapit, Kuching and Tatau districts but occurring in small populations.

Habitat. The species grows in lowland forests on limestone or mudstone substrates.

Conservation status. Least Concern. The species is widespread in Sarawak and occurs in a Totally Protected Area (Lanjak Entimau Wildlife Sanctuary) where there are no current threats.

Note. Flower colour is variable in this species, ranging from peachy orange to deep red.

Additional specimens examined. MALAYSIA: **Sarawak:** Bintulu District, Ulu Segan, 28 Aug 1968, *Ilias S27245* (SAR!); Tatau District, Bukit Setiam, 11 Jul 2014, *Julia et al. SFC4218* (SAR!), 12 July 2014, *Julia et al. SFC4229* (SAR!); Kapit District, Baleh River, Sungai Sedampa, 16 Jul 1969, *Anderson S28853* (SAR!), east slope of Hose Mt., Ulu Sg. Merirai, Batang Baleh, 28 Mar 1987, *Yii et al. S53736* (SAR!); Julau District, Sungai Mujok, 22 May 2016, *Ling & Dino, SFC5936* (SAR!); Kuching District, Padawan, Bukit Angob, 38 miles from Kuching, 6 March 1969, *Anderson S27513* (SAR!), Padawan, Bukit Manok, 13 May 1975, *Burt 8134* (SAR!); Bau District, Gunung Meraja, 17 May 1975, *Burt 8154* (SAR!).

2. *Begonia kanaensis* Kiew & C.Y.Ling, **sp. nov.**

Similar to *Begonia sabahensis* Kiew & J.H.Tan in its prostrate habit, glabrous leaves, separate male and female inflorescences produced from the prostrate stem and the yellow flowers, but it is different in its more oval lamina $8\text{--}13 \times 6\text{--}10.5$ cm with the short basal lobe 0.5–2 cm long (vs. more rotund lamina $9\text{--}10.5 \times 9\text{--}12$ cm with a well-developed basal lobe 2–4 cm long in *B. sabahensis*), longer male and female inflorescences c. 7.5 cm long and 2–3.5 cm long respectively (vs. c. 3.3 cm long in male and c. 1.5 cm long in female inflorescences) and narrower male tepals $12\text{--}14 \times 6\text{--}8$ mm (vs. $11\text{--}14 \times 8\text{--}13$ mm). – TYPE: Borneo, Sarawak, Tatau District, Sungai Kana, 21 June 2015, *Ling et al. SFC6151* (holotype SAR!; isotype KEP!). (Fig. 3)

Creeping herb, rooting at nodes. **Indumentum:** hirsute on stems, stipules and petioles, hairs red to whitish, to c. 2 mm long, denser on petioles and young shoots. **Rhizome** red-brown, unbranched, succulent, 4–5.5 mm thick, internodes 2.8–4 cm long, slightly thicker at nodes. **Stipules** pale green, ovate to oblanceolate, $5\text{--}12 \times 5\text{--}6$ mm, margin entire, apex acuminate, acumen 1–2 mm long, persistent. **Leaves** alternate, distant, oblique, held more or less vertically; petioles red-brown to pale brown, 6–12(–21) cm long, terete; lamina plain green above, paler beneath, in life succulent, glossy, glabrous above and beneath, asymmetric, broadly ovate, $8\text{--}13 \times 6\text{--}10.5$ cm, broad side 4–6.2 cm wide, base cordate, occasionally overlapping, basal lobes 0.5–2 cm long, margin entire and fringed by sparse stiff hairs, apex acuminate, acumen 1–1.5 cm long; venation pinnate-palmate, veins greenish above, pale green beneath, 2 pairs at the base, 2–3 veins on either side of the midrib, 1–2 veins in basal lobe, slightly impressed above, prominent and sparsely hispid beneath, hairs red. **Male and female inflorescences** separate, produced from leaf axils of the prostrate rhizome. **Male inflorescence** a cyme, 9.5–10.5 cm long, with up to 3 male flowers; peduncle 5–7.5 cm long. **Female inflorescence** with a single female flower; peduncle 1.8–3.6 cm. **Bracts** pale green, lanceolate, $3\text{--}5 \times 1\text{--}1.5$ mm, margin entire, glabrous, persistent; bracteole oval, $1.5\text{--}2 \times 0.7$ mm. **Male flowers:** pedicel pinkish, 22–38 mm long, glabrous; tepals 4, yellow to deep yellow, glabrous, broadly elliptic, $12\text{--}14 \times 6\text{--}8$ mm, margin entire, apex broadly acute to rounded; stamens 17–24, cluster globose, torus c. 0.75 mm long, filaments pale yellow, 1.5–2 mm long, anthers lemon yellow, ellipsoid, 1–1.5 mm long, apex emarginate. **Female flowers** not seen. **Capsules** pale green or pinkish, $13\text{--}18 \times 10\text{--}19$ mm, beak 2–3 mm long, glabrous, locules 3, placentas 2 per locule, wings 3, equal, narrowed proximally into the pedicel and distally into the beak, 2.5–6 mm

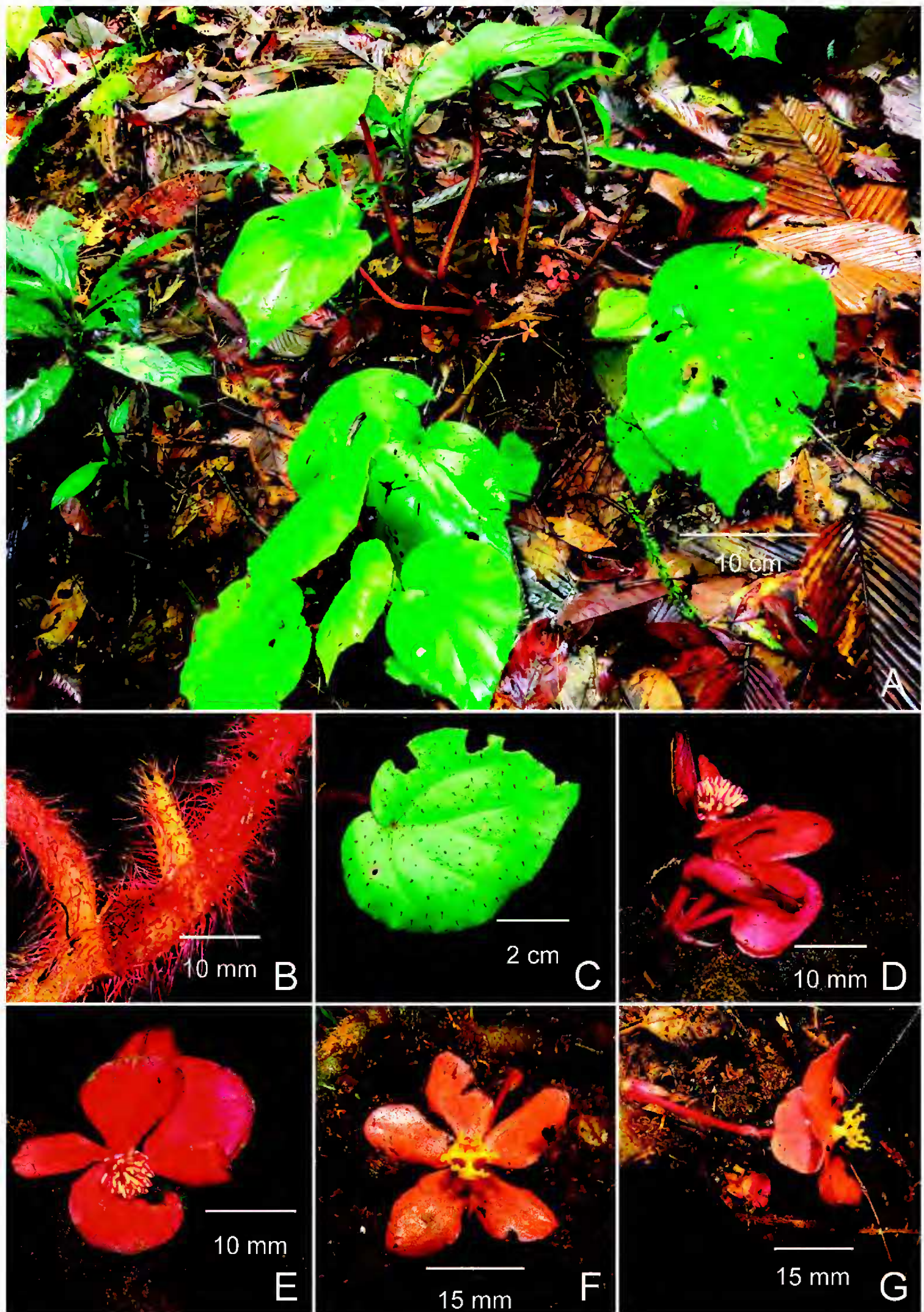


Fig. 2. *Begonia calcarea* Ridl. **A.** Habit. **B.** Stipule and stem. **C.** Upper surface of leaf. **D.** Male inflorescence. **E.** Male flower. **F, G.** Female flower. **A, F & G** from *SFC* 5936; **B–E** from *SFC*4229. (Photos: C.Y. Ling)

wide, thinly fibrous, dehiscing between locule and wing; peduncle in fruit 1.3–4.5 cm, straight; pedicel in fruit erect, 4–5 mm long.

Etymology. Named after the locality from where the type specimen was collected.

Distribution. Borneo, Sarawak. Endemic to Sarawak (Kapit and Tatau districts).

Habitat. In lowland or lower montane dipterocarp forest at 190–1500 m elevation. Creeping on deep shaded rocky bank near waterfall.

Conservation status. Endangered (EN B2ab(iii)). The species is known only from two localities in Kapit and Tatau Districts. In Tatau, the locality lies within the conservation area of Bukit Kana Management Area; elsewhere, the habitat is threatened due to local disturbance.

Additional specimens examined. MALAYSIA: **Sarawak:** Tatau District, Ulu Sangan, Bukit Kana, 14 Oct 1994, *Yii et al.* S67062 (SAR!); Kapit District, Hose Mountains, Bukit Nibong, 3 Apr 1980, *Burt* 12776 (E!, SAR!).

3. *Begonia lingiae* S.Julia, **sp. nov.**

Similar to *Begonia calcarea* in its hispid stems and petioles, succulent hairy laminae, male and female inflorescences from the prostrate stems, and its orangey yellow flowers, but it is different in its longer internodes 1–2 cm long and spaced leaves (vs. crowded into a tuft in *B. calcarea*), shorter petioles to 8.5 cm long and laminae 8–12.5 × 6–11.5 cm (vs. petioles 14–37 cm long and laminae 10–14 × 10–17 cm), much longer female tepals 12–15 × 5–7 mm (vs. c. 6 × 7 mm) and narrower capsules 10–12 × 12–15 mm with a prominent beak c. 2 mm long (vs. capsules 11–21 × 15–21 without a beak). – TYPE: Borneo, Sarawak, Tatau District, Anap Muput Forest Management Unit, Coupe 15, 22 June 2015, *Ling et al.* SFC6161 (holotype SAR!; isotype KEP!). (Fig. 4)

Creeping herb, rooting at nodes. **Indumentum:** hispid on stems, stipules and petioles, hairs dark red or sometimes white, c. 3 mm long. **Rhizomes** prostrate, pale green, unbranched, succulent, in life 5–6 mm thick, internodes 1–2 cm long, not thicker at nodes. **Stipules** pale green, ovate, 5–15 × 6–10 mm, margin entire, apex setose, seta 1–2 mm long, persistent. **Leaves** alternate, distant, oblique, held horizontally; petioles pale brown to pale green, 3.5–8.5 cm long, terete; lamina plain green above, pale green beneath, with scattered erect stiff hairs 1.5–2 mm long on both surfaces, in life succulent, matt, asymmetric, ovate, 8.5–12.5 × 6–11.5 cm, broad side 4.5–7 cm wide, base cordate, sometimes slightly overlapping, basal lobes 3–4.5 cm long, margin with scattered stiff hairs appearing minutely dentate, apex acuminate, acumen 1–1.5 cm long; venation pinnate-palmate, veins greenish on both surfaces, 4–7 veins on either side of the midrib, 3–4 veins in basal lobe, slightly impressed above, prominent

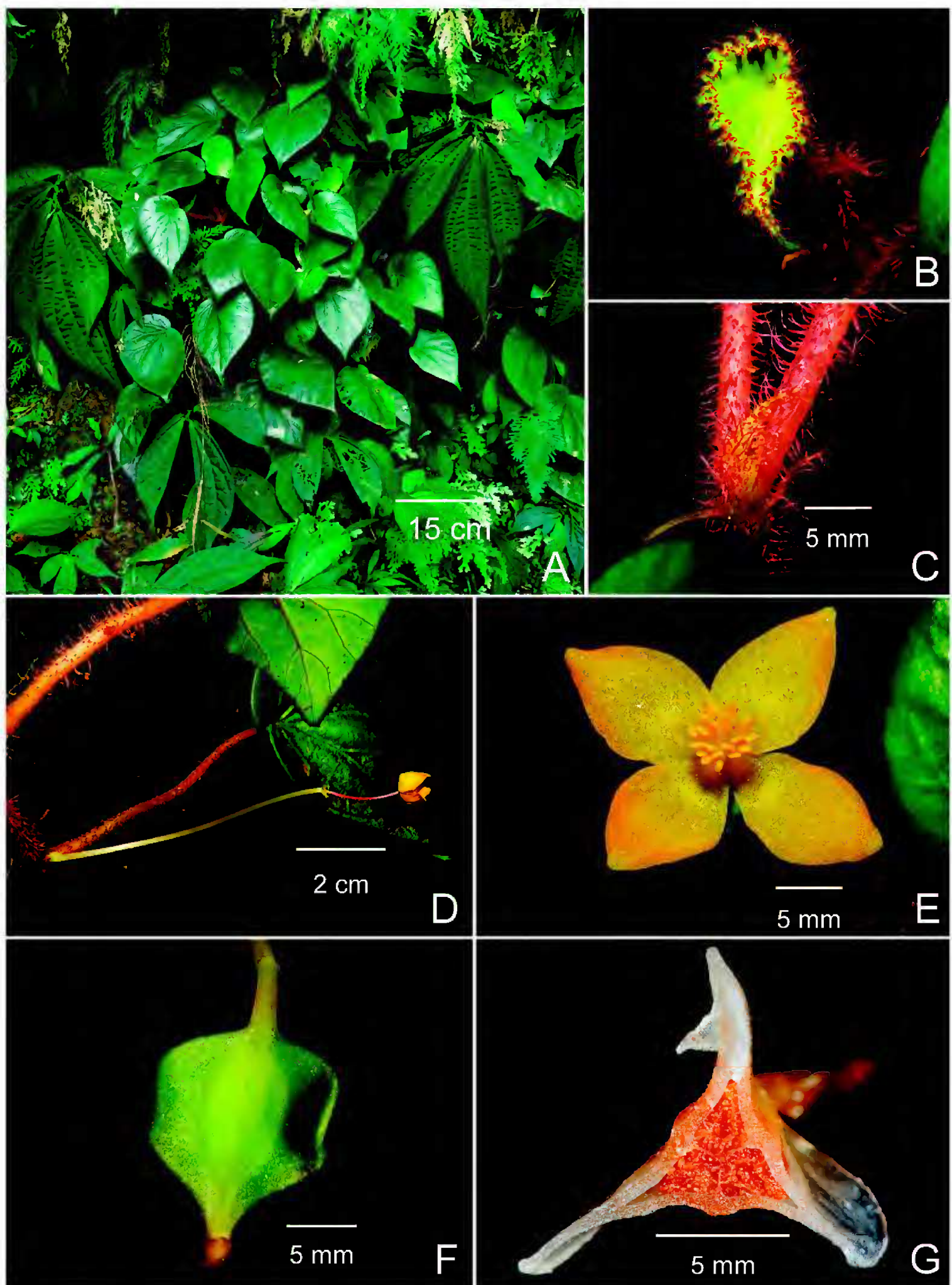


Fig. 3. *Begonia kanaensis* Kiew & C.Y.Ling. **A.** Habit. **B.** Young leaf. **C.** Stipule. **D.** Male flower with long peduncle. **E.** Male flower with isomorphic tepals. **F.** Fruit. **G.** Cross-section of fruit. From the type *SFC6151*. (Photos: C.Y. Ling)

beneath. **Male and female inflorescences** separate, produced from the leaf axils from the prostrate rhizome. **Male inflorescence** a cyme, c. 5.5 cm long; peduncle 2.3 cm long, pale pink to slightly yellowish. **Female inflorescence** with a single flower, peduncle 1–2 cm long. **Bracts** pale green, ovate to lanceolate, $2\text{--}4 \times 2\text{--}4$ mm, margin entire, persistent; bracteoles similar to bracts, pale green, $2\text{--}2.5 \times 1\text{--}1.5$ mm, margin entire, persistent. **Male flowers:** pedicel pinkish, c. 20 mm long, glabrous; tepals 4, yellow to deep yellow, tinged orange at the margin, glabrous, outer 2 tepals broadly elliptic, $9\text{--}10 \times 7\text{--}8$ mm, margin entire to minutely serrate, apex broadly acute to rounded, inner 2 tepals obovate to broadly oblanceolate, $8\text{--}9.5 \times 5\text{--}6.5$ mm; stamens c. 23, cluster globose, sessile, filaments pale yellow, 1.5–2 mm long, anthers lemon yellow, ellipsoid, 1–1.5 mm long, apex emarginate. **Female flowers:** pedicel pale green, 2–3 mm long, glabrous; tepals 5, pale green when young, yellow tinged orange at apex when open, glabrous, obovate, $12\text{--}15 \times 5\text{--}8$ mm, margin entire or sometimes minutely toothed, apex acute; ovary pale green tinged pink at wings, broadly obovate, $10\text{--}13 \times 13\text{--}16$ mm, glabrous, beaked to 3 mm long, wings 3, equal, locules 3, placentas 2 per locule; styles 3, pale yellow, 4–5 mm long, divided to base, deeply Y-shaped; stigma pale yellow, papillose forming a continuous twisted band. **Capsule** single, $10\text{--}12 \times 12\text{--}15$ mm with a beak c. 2 mm long, glabrous, locules 3, wings 3, equal, broadly acute proximally, rounded to truncate distally, 3–5 mm wide, thinly fibrous, dehiscing between locule and wing; peduncle in fruit 1–2 cm long, slightly pendent, pedicel in fruit 0.2–1 cm long.

Etymology. Named for Ling Chea Yiing (1983–present), research officer specialising in orchid taxonomy, in Sarawak Forestry Corporation, who first collected the species.

Distribution. Borneo. Endemic in Sarawak. So far known only from the type locality.

Habitat. Disturbed lowland mixed dipterocarp forest at 335 m elevation, near a cliff, on sandstone boulders.

Conservation status. Critically Endangered (CR B2ab(iii)). The species is known only from a single locality that lies outside the network of Totally Protected Areas and the habitat is threatened by logging activities that open up the canopy and cause siltation.

4. *Begonia rubrotepala* S.Julia, sp. nov.

This species is unique among Bornean begonias for its 10–45 cm long, slender inflorescences that trail on the ground with only the apical portion erect, compared with others where the inflorescences are axillary on erect stems. Among the ‘calcarearea group’, its inflorescence is different in that the same peduncle produces a single basal female flower followed by male flower(s) whereas in the other species male and female flowers are produced on separate inflorescences. In its petiole as long or longer than the lamina and its lamina more or less glabrous and broader than long with a well-developed basal lobe, it most resembles *B. sadirensis*, but its leaves are smaller

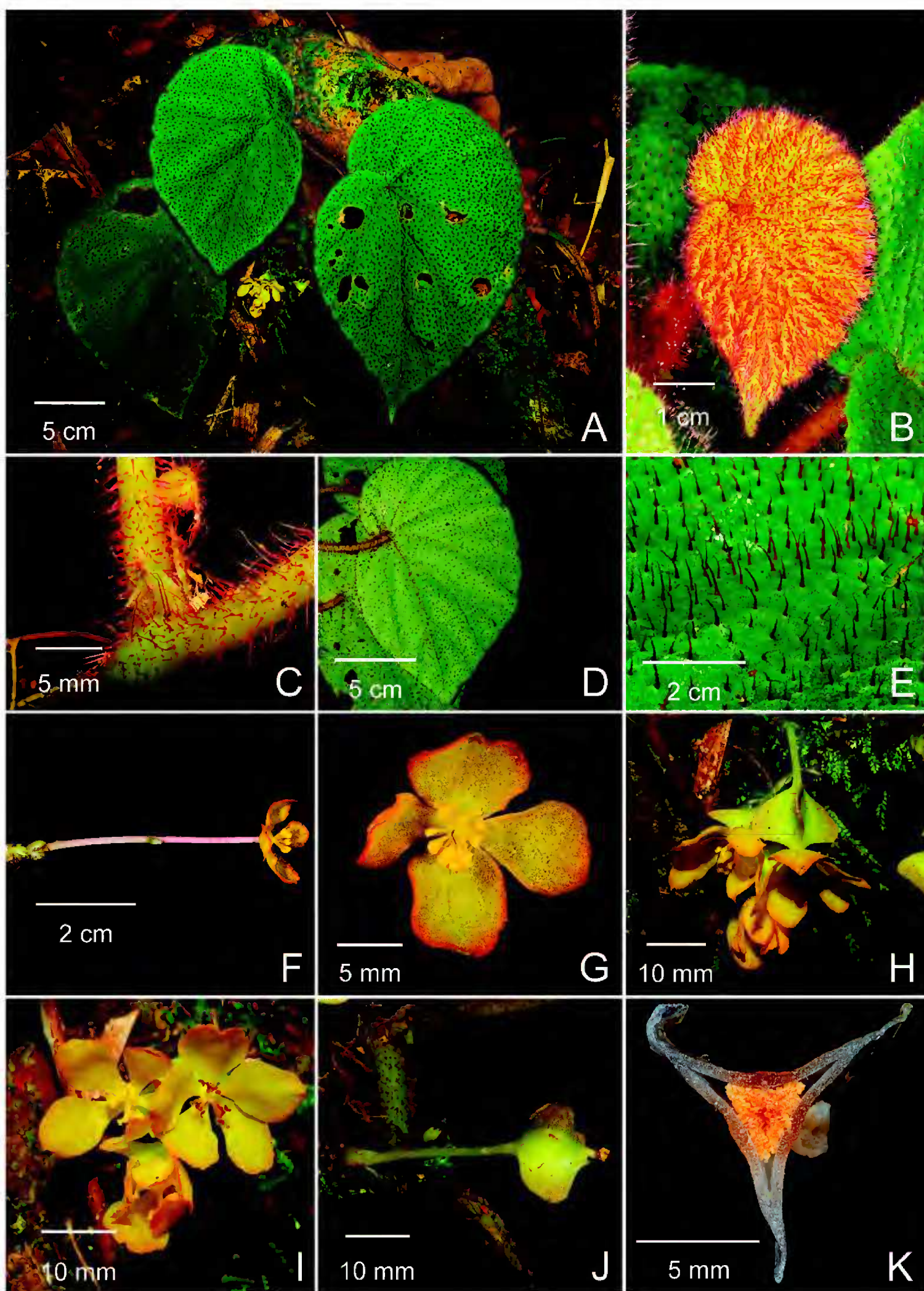


Fig. 4. *Begonia lingiae* S.Julia & Kiew. **A.** Habit. **B.** Young leaf. **C.** Stipule. **D.** Under surface of leaf. **E.** Close-up of upper leaf surface. **F, G.** Male flower. **H, I.** Female inflorescence. **J.** Fruit. **K.** Cross-section of ovary. From the type *SFC6161*. (Photos: C.Y. Ling)

8.5–13 × 8.5–16.5 cm with the basal lobe 1–3.5 cm long (vs. 13–17.5 × 13.3–19 cm with basal lobe 3.5–5 cm in *B. sadirensis*), its bracts are larger 15–22 × 6–8 mm (vs. 5–7 × 3 mm), its flowers are bright red (not deep orangey red), the pedicel of the male flower is short 6 mm long (vs. 5–22 mm), the outer tepal pair larger 11–12 × 9–10 mm (vs. 5–8 × 4–7 mm), stamens many 32–47 (vs. 23–27) and the capsule smaller 8–9 × 11–12 mm (vs. 12–15 × 15–17 mm) with a longer stalk 6–7 mm (vs. 2.5–4.5 mm). – TYPE: Borneo, Sarawak, Lubok Antu District, Ulu Engkari, Lanjak Entimau Wildlife Sanctuary, Sungai Segerak, 12 March 2016, *Julia et al.* SFC3453 (holotype SAR!; isotypes KEP!, SING!). (Fig. 5).

Creeping herb 25–45 cm long, rhizome and petiole covered with short soft white hairs (hairs reddish on young stem and petiole). **Rhizomes** dull brown, 8–10 mm thick, internodes (2.5–)5.5–10 cm long, unbranched, very succulent, slightly thicker at nodes. **Stipules** red-brown, ovate, 20–22 × 10–12 mm, margin entire, keeled, apex acuminate, seta to 5 mm long, caducous. **Leaves** alternate, 5–6 leaves per plant, distant, oblique, held horizontally; petioles dull dark brown, (10–)15–25 cm long, c. 6 mm diameter, terete, pilose, hairs brownish; lamina plain, dark green above, pale green beneath, young leaves olive green above, greenish beneath, in life succulent, matt, hirsute above, hairs short, stiff and dark brown, asymmetric, broadly ovate or almost rounded, (8.5–)10.5–13 × (8.5–)13–16.5 cm, broad side (5.5–)7.5–9.5 cm wide, base cordate, overlapping, basal lobes 1–3.5 cm wide, margin minutely serrate, apex acute; venation palmate, veins greenish above except near the leaf base, brownish or reddish beneath, veins 4 on either side of the midrib, 2 veins in basal lobe, prominent above, strongly prominent beneath; tertiary veins very conspicuous beneath, reticulate. **Inflorescences** protogynous, axillary opposite the leaf, 2–3 inflorescences per rhizome, horizontal on the ground, racemose, 10–45 cm long, red-brown. **Bracts** ovate, red brown, densely pilose, hairs reddish, keeled, 15–20 × 6–8 mm, apex setose, seta 2 mm long; bracteoles reddish brown, lanceolate or elliptic, lower bracteoles c. 10 × 6 mm, upper bracteoles c. 6 × 6 mm, margin toothed. **Male flowers:** pedicel red, c. 6 mm long, glabrous; tepals 4, anisomorphic, outer 2 tepals deep red outside, pinkish inside, outside covered with dense red hairs, inside glabrous, rounded, 11–12 × 9–10 mm, margin entire, apex rounded, inner 2 tepals whitish tinged red, glabrous, lanceolate, c. 8 × 4 mm, margin entire, apex acute; stamens 32–47, cluster globose, sessile, filaments pale to lemon yellow, c. 1 mm long, anthers pale to lemon yellow, obovate, c. 1 × 0.5 mm, apex emarginate. **Female flowers:** pedicel red, 7–10 mm long; tepals 5, rarely 6, outer 3–4 tepals broadly elliptic, 10–11 × 5–7 mm, bright red outside, reddish or whitish inside, margin entire, apex broadly acute, inner 2 tepals smaller, narrowly elliptic, 9–10 × 3 mm, pinkish; ovary bright red, covered with white or red hairs to 2 mm long, c. 10 × 13–16 mm, wings 3, equal, 5–6 mm wide, locules 3, placentas 2 per locule; styles 3, lemon yellow, c. 2 mm long; stigma yellow, widely Y-shaped, papillose forming a continuous twisted band. **Capsules** 8–9 × 11–12 mm, locules 3, wings 3, equal, rounded proximally and distally, 4–6 mm wide, dehiscing between the locules and wings; peduncle in fruit 8–19 cm long, not pendent; pedicel in fruit thread-like, 6–7 mm long.



Fig. 5. *Begonia rubrotepala* S. Julia. **A.** Habit. **B.** Stipule. **C.** Young leaf. **D, E.** Inflorescence. **F.** Male flower. **G, H.** Female flower. **I.** Cross section of ovary. From type *SFC3453*. (Photos: S. Julia)

Etymology. From the tepal colour (Latin, *rubro* = red; *tepala* = tepal).

Distribution. Borneo. Endemic in Sarawak, known from Lubok Antu District (Batang Ai National Park), Song District (Lanjak Entimau Wildlife Sanctuary) and the Belaga District.

Habitat. Riparian forest, on steep or gentle slopes less than 5 m from the water's edge, on clayey soils.

Conservation status. Least Concern. The species is commonly seen in Totally Protected Areas (Batang Ai National Park and Lanjak Entimau Wildlife Sanctuary).

Notes. This is a striking species in its bright red flowers. The only other begonia in this group with red flowers is the Bintulu population of *Begonia calcaria*. Its 10–45 cm-long, slender inflorescences are unique among Bornean begonias in that they trail on the ground with only the apical portion erect. On the same inflorescence they produce a single female flower followed by male flowers compared with other species in the 'calcaria group' where male and female flowers are produced on separate inflorescences. In addition, the bracts are large and more prominent. It is also the only species in the 'calcaria group' that does not have male flowers with isomorphic tepals.

Additional specimens examined. MALAYSIA: **Sarawak:** Lubok Antu District, Batang Ai National Park, Sungai Bebilong Besai, 2 Aug 2015, *Julia et al.* SFC2756 (SAR!); Lubok Antu District, Batang Ai National Park, Sungai Bukoh, 17 Mar 2016, *Julia et al.* SFC3485 (SAR!); Lubok Antu District, Batang Ai National Park, Sg. Kenaban, 18 Mar 2016, *Julia et al.* SFC6623 (SAR!); Lanjak Entimau PF, Sg. Jelok, near Bukit Sengkajang, 18 Mar 1974, *Chai S34013* (SAR!); Song District, Ulu Katibas, Lanjak Entimau Wildlife Sanctuary, on ridge going west up across Sg. Menyarin towards Ulu Menyarin, close to Camp A, base of ridge running SW, 21 Nov 1997, *Pearce et al.* ITTO/BB0732 (SAR!); Belaga District, up River ex Punan Busang, 18 Jun 1971, *Goh & Samsuri GSY703* (SAR!).

5. *Begonia sabahensis* Kiew & J.H.Tan, Gard. Bull. Singapore 56: 73 (2004); Kiew et al., Guide to Begonias of Borneo 244 (2015). – TYPE: Sabah, Tenom District, Sungai Telekosen, 11 February 2004, *Recin Sapau & Tan, J.H.* AL727/2004 (holotype SAN!). (Fig. 6)

Distribution. The species is known only from the type locality.

Habitat. In transition forest between hill and lower montane forests on steep shaded slopes.

Conservation status. Critically Endangered (CR B2ab(iii)). It is extremely rare with a small population that is outside the network of Totally Protected Areas and currently in danger of habitat disturbance from logging activities.

6. *Begonia sadirensis* Kiew & S.Julia, **sp. nov.**

Similar to *Begonia sabahensis* Kiew & J.H.Tan in its stout petiole that is as long or longer than the lamina, its lamina broader than long, and lamina more or less glabrous above, but it is different from *B. sabahensis* in having larger laminae, 13–17.5 × 13.5–

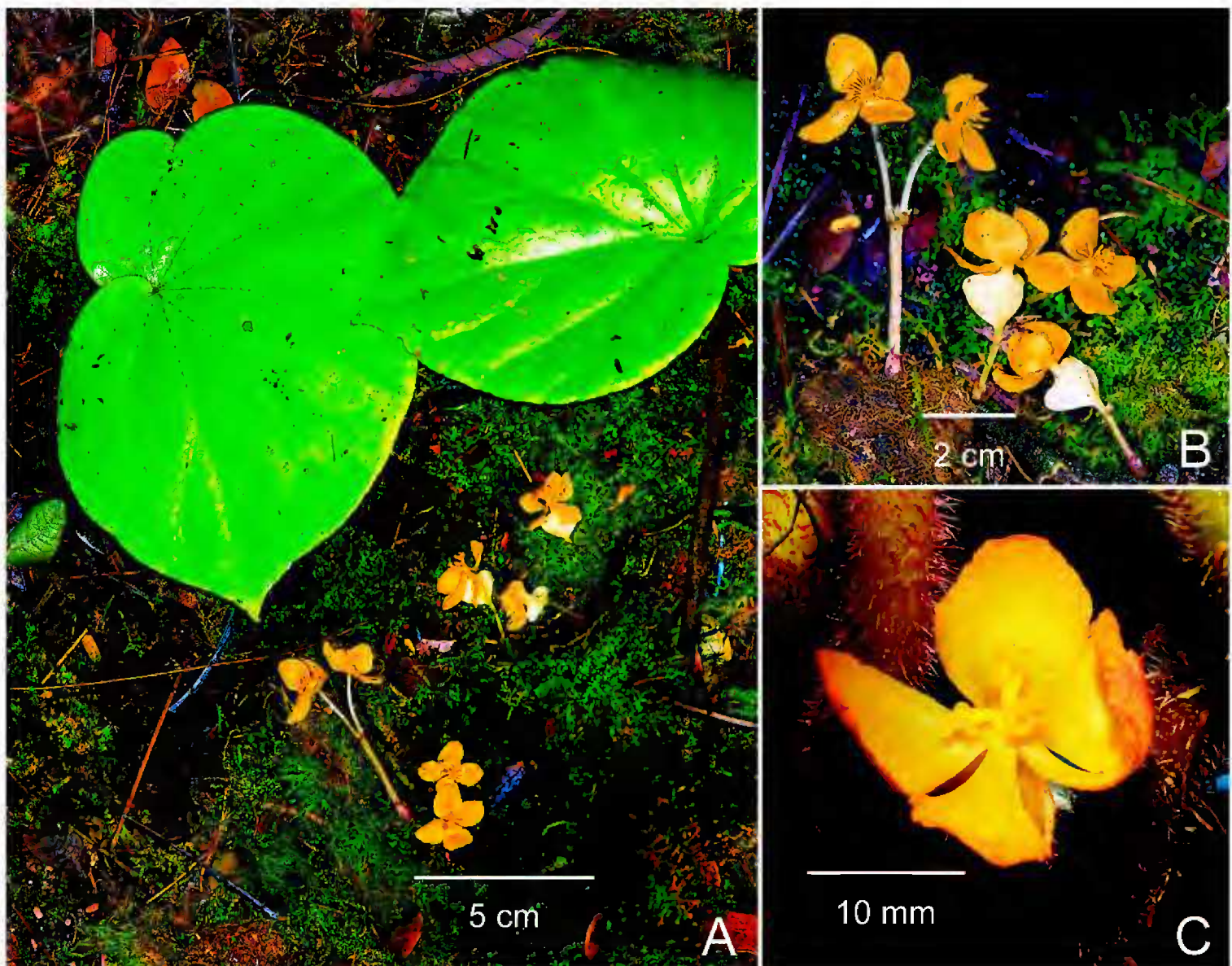


Fig. 6. *Begonia sabahensis* Kiew & J.H.Tan. **A.** Habit and inflorescence. **B.** Male and female inflorescence. **C.** Female flower. All photos reproduced with permission from Kiew et al., 2015.

19 cm (vs. laminae c. 10 × 12 cm), longer petioles (12–)17.5–32.5 cm (vs. petioles 8–17 cm) and orangey red flowers (vs. flowers yellow). – TYPE: Borneo, Sarawak, Padawan District, Kampung Sadir, 11 July 2015, *Julia et al.* SFC6173 (holotype SAR!). (Fig. 7).

Creeping herb to 30 cm long, rhizome prostrate, rooting at nodes. Rhizomes, stipules, petioles and both surfaces of veins hispid with appressed hairs, more noticeable on petioles and young shoots. **Rhizomes** red-brown, unbranched, succulent, 6–11 mm thick, internodes 2–4 cm long, slightly thickened at nodes. **Stipules** red-brown, broadly lanceolate, 14–24 × 7–15 mm, keeled, densely shortly hispid, margin entire, apex acute, persistent. **Leaves** alternate, distant, oblique, held horizontally; petioles stout, red-brown, (12–)17.5–32.5 cm long, appressed hispid, grooved above; lamina plain green, paler beneath, in life succulent, glabrous with the occasional hairs above, glossy, asymmetric, ovate, 13–17.5 × 13.3–19 cm, broad side 8.3–11.2 cm wide, base deeply cordate and overlapping, basal lobes 3.5–5 cm long, margin minutely toothed, teeth tipped by a hair, apex acuminate, acumen c. 2 cm long; venation palmate-pinnate, 2 pairs at the base, 2–3 veins on either side of the midrib, 2–3 veins in basal lobe,

veins plane above, prominent and ferrugineous below. **Plant** protogynous. **Male inflorescences** from upper leaf axils, slender, 1.5–4.5 cm long, a cyme 3–6 cm long; peduncle 2.2–3.2 cm long. **Bracts** several congested at base, reddish to pinkish, narrowly lanceolate, 5–7 × 3 mm, margin entire, glabrous, persistent; bracteoles ovate, c. 3 × 2 mm, glabrous, margin entire, caducous. **Female inflorescence** (young) from lower leaf axil, a compound cyme to 2 cm long. **Bracts** red to pale pink, lanceolate to oblanceolate, c. 6 × 2 mm, margin entire, apex setose, seta to 1 mm long, persistent; bracteoles pinkish, lanceolate, c. 5 × 2 mm, margin entire, apex setose, seta to 1 mm long, persistent. **Male flowers:** pedicel pinkish, (5–)10–22 mm long, glabrous; tepals 4, orangey red, glabrous, broadly ovate, 5–8 × 4–7 mm, margin entire, apex rounded; stamens 23–27, cluster globose, sessile, filaments pale yellow, 2–2.5 mm long, anthers lemon yellow, obovate, 1–1.5 × 0.5 mm, apex emarginate. **Female flowers:** pedicel pale pink, c. 3 mm long, glabrous; tepals 5, orangey red, glabrous, elliptic, 8–9 × 4–5 mm, margin entire, apex broadly acute; ovary deep pink particularly the wings, pale pink at centre, ovoid, c. 12 × 18 mm, glabrous, wings 3, equal, locules 3, placentas 2 per locule; styles 3, lemon yellow, c. 3 mm long, divided to base, widely anchor-shaped; stigma yellow-orange, papillose forming a continuous twisted band. **Capsules** 1–5 from the lower leaf axil, whitish or pale red, 12–15 × 15–17 mm, glabrous, locules 3, wings 3, unequal, broadly acute proximally and distally, 4–7 mm wide, thinly fibrous, dehiscing between locule and wing; peduncle in fruit 2.5–5 cm long, slightly pendent; pedicel in fruit pendent, 2.5–4.5 mm long.

Etymology. Named after the type locality.

Distribution. Borneo. Endemic in Sarawak. Known only from the type locality.

Habitat. A disturbed seasonal creek, near sandstone boulders or rock faces along a small stream.

Conservation status. Critically Endangered (CR B2ab(iii)). The species is known only from a single locality outside the network of Totally Protected Areas. The habitat is threatened due to local disturbance.

Discussion

The large genus *Begonia*, which is among the ten largest genera of vascular plants (Frodin, 2004), has more than 1825 species worldwide (Hughes et al., 2015). The most recent comprehensive sectional classification of the genus is that by Doorenbos et al. (1998). The sections that include Bornean species are *Begonia* sect. *Diploclinium* (Lindl.) A.DC., *Begonia* sect. *Petermannia* (Klotzsch) A.DC., *Begonia* sect. *Reichenheimia* (Klotzsch) A.DC. and *Begonia* sect. *Sphenanthera* (Hassk.) Warb. Recently a further section, *Begonia* sect. *Baryandra* A.DC., was redefined and now includes a few Bornean species that were previously included in *Begonia* sect.

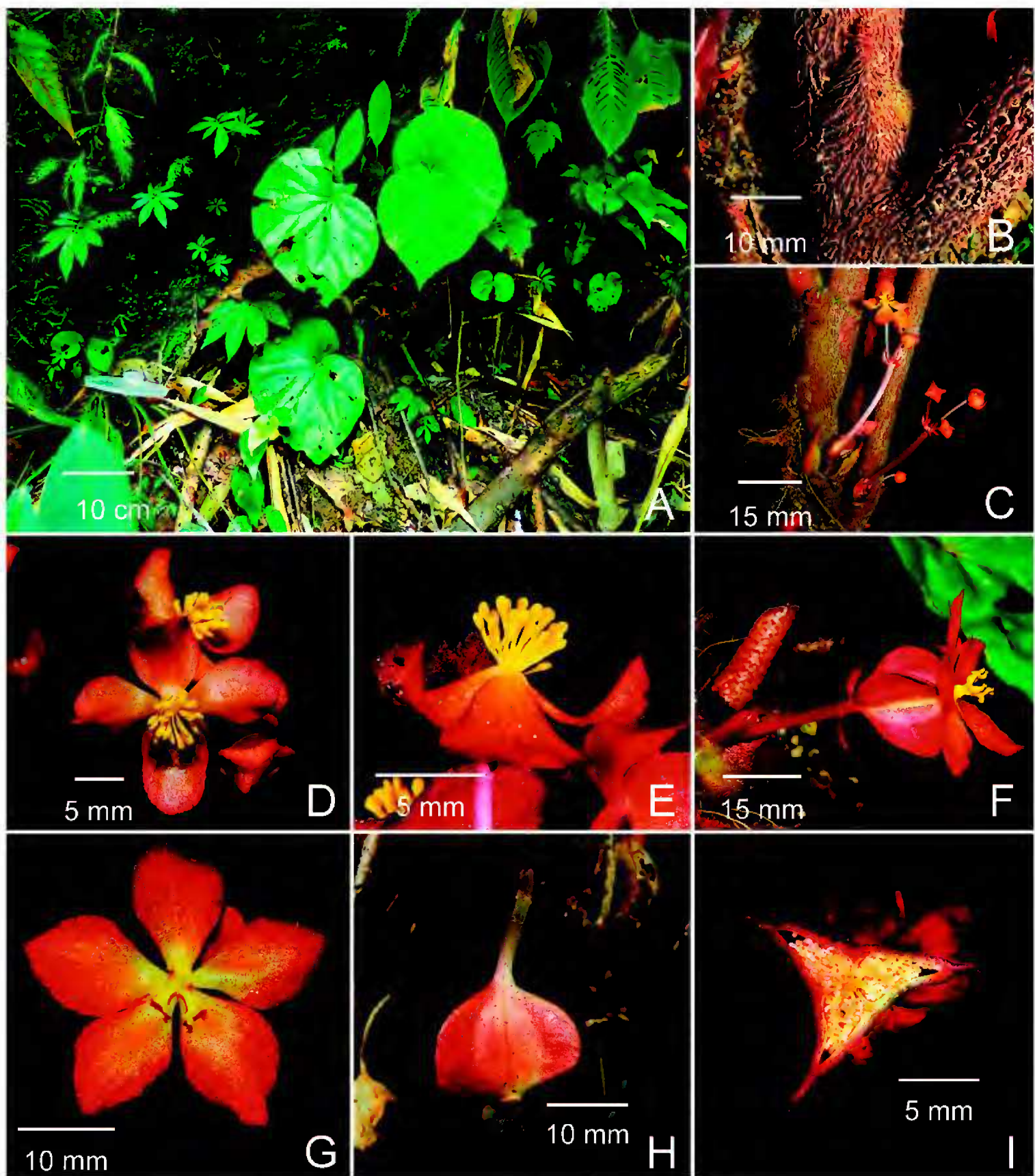


Fig. 7. *Begonia sadirensis* Kiew & S. Julia. **A.** Habit. **B.** Stipule. **C.** Male inflorescence. **D, E.** Male flowers. **F, G.** Female flower. **H.** Fruit. **I.** Cross-section of ovary. From the type *SFC6173*. (Photos: C.Y. Ling)

Diploclinium (Rubite et al., 2013). Doorenbos et al. (1998) doubtfully placed *Begonia calcarea* in *Begonia* sect. *Diploclinium* Group I on account of it possessing rhizomes, an ovary with three locules and bilamellate placentas, and dry capsules. Group II of *Begonia* sect. *Diploclinium* included species from continental Asia, many of which were tuberous. Based on morphology, *Begonia* sect. *Diploclinium* was clearly a problematic group being heterogeneous and polymorphic.

Thomas et al. (2011) noted that *Begonia* sect. *Diploclinium* had become a dustbin and that phylogenetic analyses clearly demonstrated that *Begonia* sect. *Diploclinium* was polyphyletic. In their analysis, *Begonia* sect. *Diploclinium* included two distinct clades: the continental Asian species with tubers (part of their Clade C) and the rhizomatous Malesian species (Clade D). The type species for *Begonia* sect. *Diploclinium*, *Begonia grandis* Otto ex A.DC, belongs to the tuberous group, which formed a basal grade in the analyses of Thomas et al. (2011) in a clade also comprising species of *Begonia* sect. *Sphenanthera* and *Begonia* sect. *Platycentrum*. Sectional delimitation within this group needs to be revised.

Rubite et al. (2013) examined the rhizomatous Malesian *Begonia* sect. *Diploclinium* group, which has a centre of diversity in the Philippines, in detail and concluded that they were distinct from continental species of *Begonia* sect. *Diploclinium*. They expanded and redefined *Begonia* sect. *Baryandra* to accommodate these species. While the majority of species in this section are from the Philippines (40 species), a few occur in Borneo (5 species) and New Guinea (7 species). Of the remaining Bornean rhizomatous species from *Begonia* sect. *Diploclinium*, they note that *B. calcarea* and *B. sabahensis* have no affinity with *Begonia* sect. *Baryandra* but that it was not clear to which section they belong.

On morphological grounds (see Introduction) the ‘calcareum group’ of species is clearly distinct from the other sections occurring in Borneo. However, until its species are included in phylogenetic analyses (material will be DNA sequenced in the near future) and molecular data used to shed some insight into whether they form a monophyletic group that is distinct from the other sections, it is premature to erect a new section to accommodate them.

Apart from *Begonia calcarea*, the other species in the ‘calcareum group’ are to date known only from one or two localities (Fig. 1). In addition, they all occur as small populations, which make them particularly vulnerable to habitat disturbance. Of these narrowly distributed species, only *Begonia rubrotepala* lies within the network of Totally Protected Areas (i.e., within the Batang Ai National Park and Lanjak Entimau Wildlife Sanctuary) whereas the other species (*B. kanaensis*, *B. lingiae*, *B. sabahensis* and *B. sadirensis*) occur outside Totally Protected Areas. *Begonia lingiae*, *B. sabahensis* and *B. sadirensis* are threatened by habitat disturbance from logging activities or local disturbance and therefore fall within the Critically Endangered category while *B. kanaensis* is considered Endangered. *Begonia calcarea* is also considered Least Concern as the localities are widespread and include a Totally Protected Area (Lanjak Entimau Wildlife Sanctuary).

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